Analyzing Boron in 9–12% Chromium Steels Using Atom Probe Tomography

Small additions of boron can remarkably improve the long-term creep resistance of 9–12% Cr steels. The improvement has been attributed to boron segregation to grain boundaries during quenching, and subsequent boron incorporation into certain families of precipitates during tempering. However, the detailed mechanisms are not yet fully understood. Atom probe tomography (APT) is an excellent technique for gaining insights into boron distribution, however, in order to acquire accurate analysis of boron in 9–12% Cr steels using APT, there are several key challenges. In order to better understand and address these challenges, we developed a novel method for site-specific APT specimen preparation, which enables convenient preparation of specimens containing specifically selected grain boundaries positioned approximately perpendicular to the axis of the APT tip. Additionally, when analyzing boron at boundaries and in carbides (as diluted solute) and borides, a widening of the profile of boron distribution compared to other elements was repeatedly observed. This phenomenon is particularly analyzed and discussed in light of the evaporation field of different elements. Finally, the possible effects of detector dead-time on quantitative analysis of boron in metal borides are discussed. A simple method using $^{10}\text{B}$ correction was used to obtain good quantification.